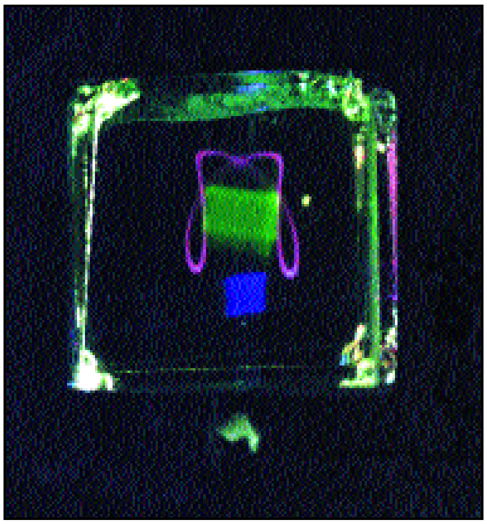
3-D PICTURE IN A CUBE



● *This prototype display offers true 3-D without illusions.*

BMDO HISTORY

3-D Technology Laboratories (Mountain View, CA) was founded by Elizabeth Downing, Ph.D., in 1996. Her pioneering work in 3-D display technology at Stanford University generated enormous interest and earned widespread publicity. Along with a number of agencies, BMDO is helping to support her research in rare-earth-doped glass display technology through a Phase I SBIR contract. The applications are numerous, ranging from medical imaging and air traffic control displays and battlefield management monitors to video games and virtual-reality entertainment devices.

Some neuroscientists theorize that we store information in our brains holographically, with each memory stored in several places simultaneously. When we remember something, all these areas are alerted at the same time from one prompting neuronal signal, much as a laser can tease out an entire image from a hologram with one beam. Perhaps this is why we relish 3-D reconstructions.

HOW IT WORKS

The system uses two computer-controlled infrared lasers to trace its 3-D pictures inside a cube of special laminated glass, much as the electron beam from a cathode ray tube traces a 2-D image on a television screen. The energy generated at the point where the invisible laser beams intersect makes a single point of the glass glow with visible light—a precise dot like a video screen pixel seemingly suspended in space. “This allows you to address a pixel anywhere inside a three-dimensional volume, and then by scanning rapidly, you can draw three-dimensional images,” says Downing. The fluorescent glass display uses several rare-earth compounds that emit different colors of visible light when struck by the laser beam. By varying the chemistry of the glass, the designers are able to generate red, blue, and green light and mix them to create all the components necessary for a full-color display.

The prototype display is about a cubic inch in volume, and the pictures it contains are simple three-color line drawings, which serve as test patterns. But its developers said they are confident that they can quickly make the viewing system larger while making its support electronics smaller. Standing between the developers and any immediate commercial application are technical obstacles such as the cost of the high-purity materials needed to manufacture the special rare-earth glass used in the display cube. In addition, the processing demands imposed by data-intensive, high-resolution imaging are quite high.

MEDICAL SIGNIFICANCE

The display draws real volumetric images. As a result, all the normal depth cues that are used for visualization can be applied, independent of the user's head position. No processing has to be done to update the view when the user's perspective changes. This is one of the primary differences between true 3-D and virtual-reality or stereoscopic displays—no latency due to rendering scenes from a new direction. The unique advantages of this system lend themselves exceptionally well to medical imaging.

The display can offer models of anatomy that are not limited by the usual obscuring barriers. As an example, a surgeon could observe a transparent view of the human brain, seeing the skull and all the internal structures at once, as if they were made of glass. This is an interesting way to look at physical models. It takes virtual reality beyond what is possible in actual reality—to see any solid as a sort of 3-D line drawing. By referring to landmarks in the display, surgeons can be more confident that they are avoiding vital arteries and other areas as they move their instruments. A different view can be obtained by simply looking at a different part of the display.

● *Designs can range from whimsically simple to complex.*

As a teaching tool, current 3-D displays are already immensely popular. Animation and viewability from any angle are further advantages of the new technology. The heart in motion, for instance, is a far more informative representation than a static model.

VENTURES OR PRODUCT AVAILABILITY

This technology is in the research phase. Downing has obtained generous support from the National Science Foundation, the Air Force, the Defense Advanced Research Projects Agency, and the National Aeronautics and Space Administration, and is submitting a Phase I SBIR proposal to the National Institutes of Health. She has recently made a technical advance by incorporating praseodymium into a ceramic glass, which could reduce the cost of materials.

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